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Title: GRING18 Corrosion Characterization

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GRING18 Corrosion Characterization

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Special thanks to Ed Romero for helping with sample transport and Ken Wilson for sectioning the Hagan piece

Los Alamos NATIONAL LABORATORY EST.1943

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Experimental Objectives

- Image contaminated samples
- Obtain distributions of features on samples

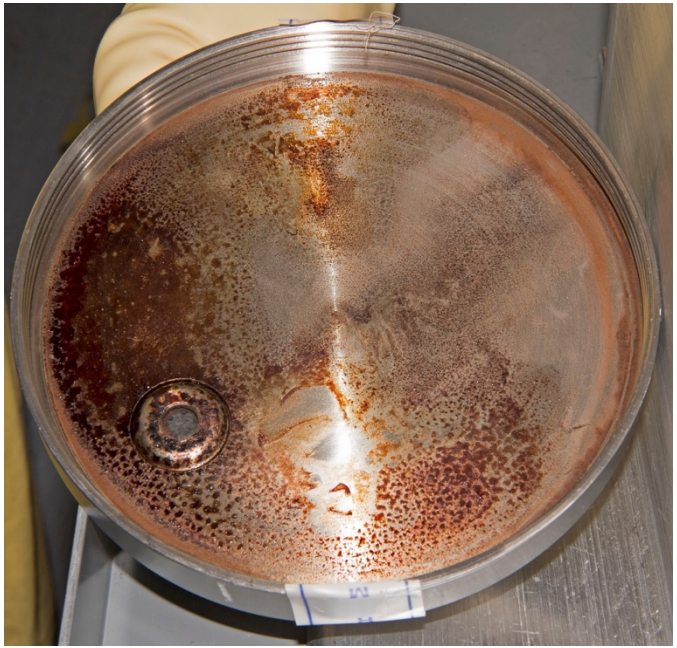
Inside PF4

- Qualitative set of images
- Good for identifying samples with features of interest

LCM images

- Quantitative set of images
- Depth distributions can be obtained

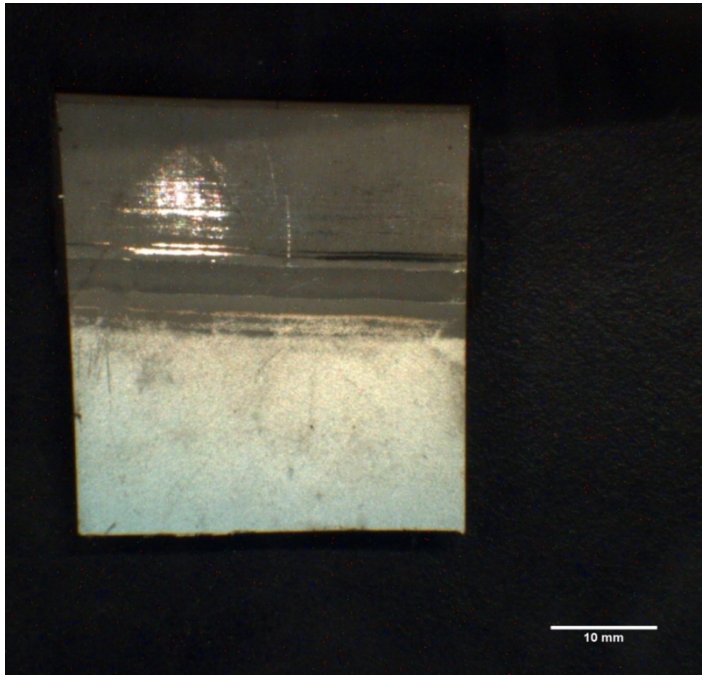
GRING18 Camera Photos

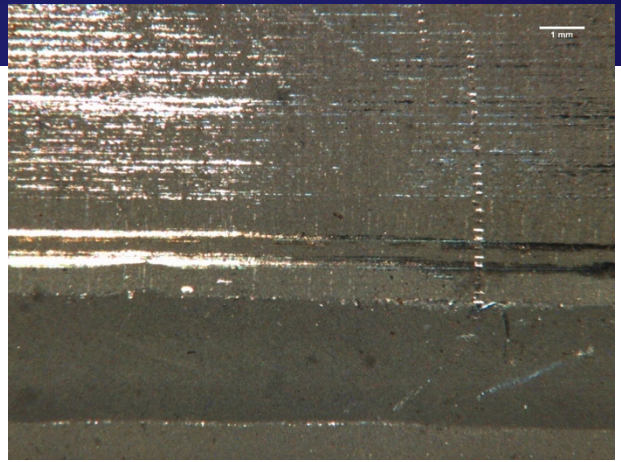


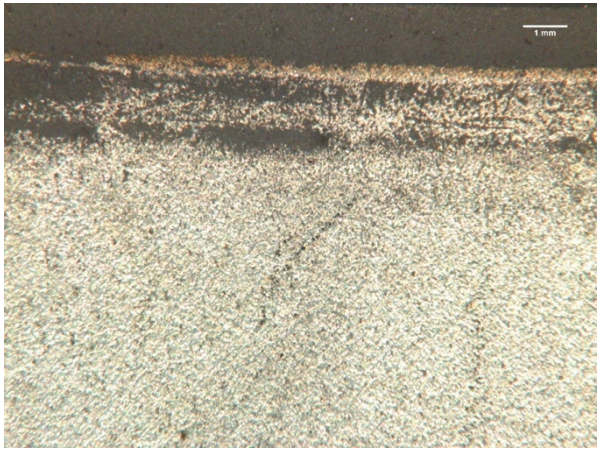
Courtesy TA55 Photo Team

Macro Photos

Glove-box (GB) microscope







Machined area of wall has areas that appear dull due to general corrosion. The general corrosion extends for about 1 cm below the weld.

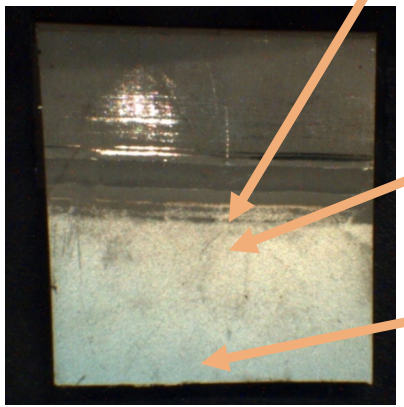
Microscopic photos were taken above, on, and below the weld to the bottom of the wall piece.

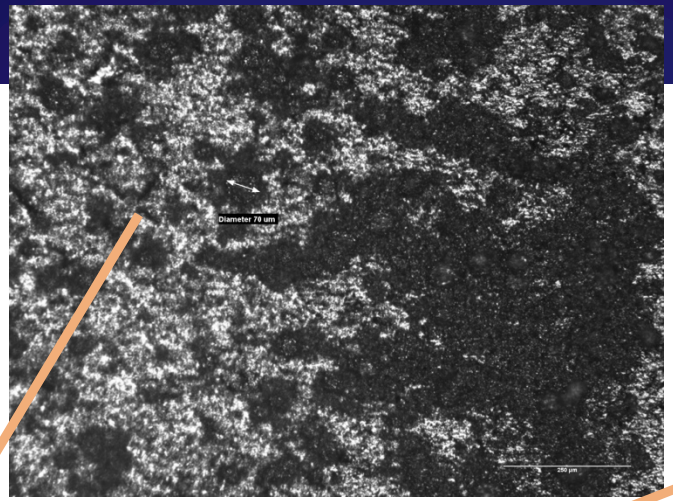
NOTE: All microscopic images that follow are rotated 90 degrees to the right.

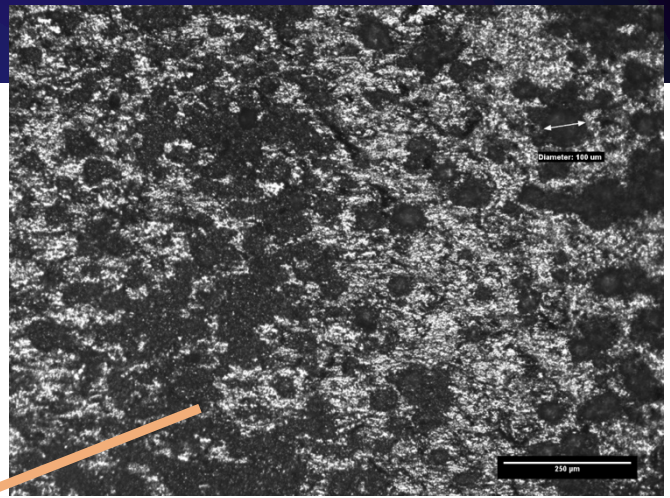
Survey of Wall Piece

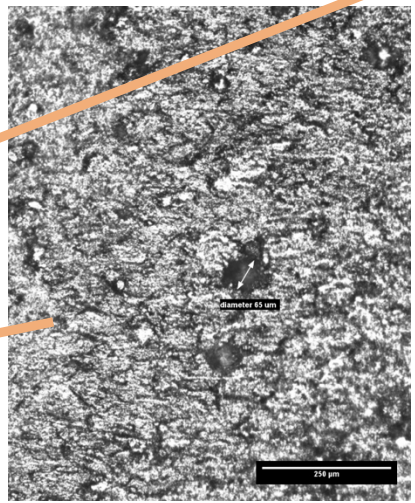
Glove-box (GB) microscope

(10x magnification) Inside glove box in PF4







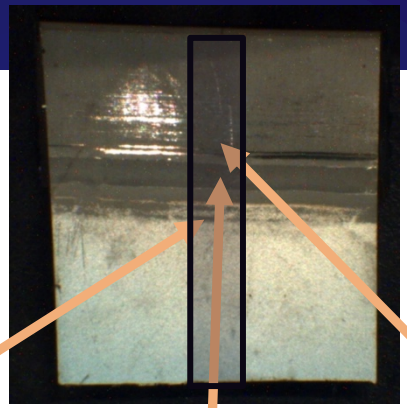


Just below the weld, the wall has eroded areas with numerous corrosion pits. Pits ranged in size from 40 up to 100 microns in diameter. The highest concentrations of pits were observed within 1 cm of the weld.

Ratio of depth/diameter is about 2

Survey of Wall Piece

Inside glove box in PF4

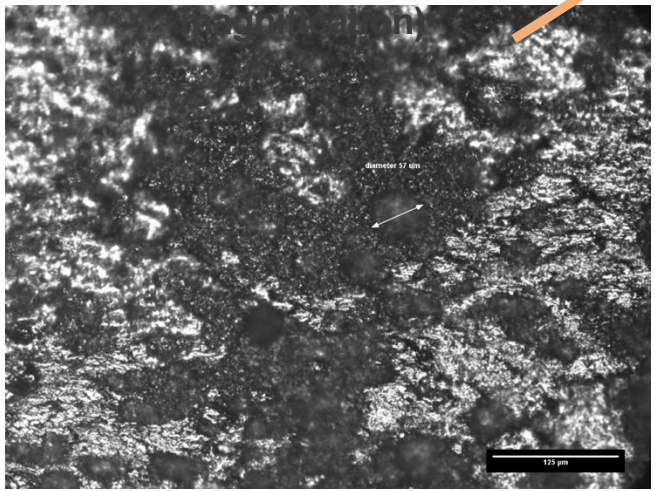


Largest pits observed just below weld.

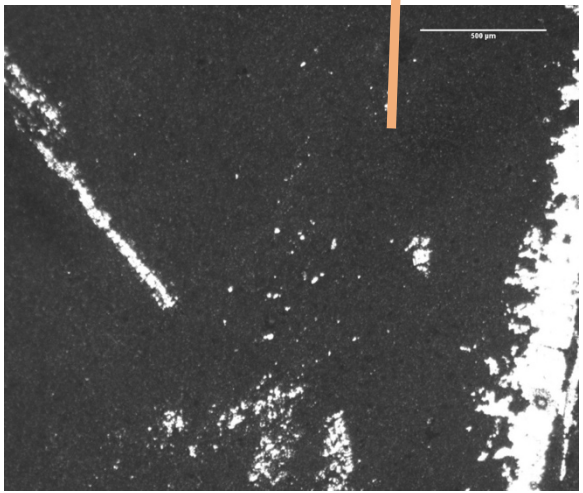
No pits observed on weld.

Very small pits on machined surface above weld.

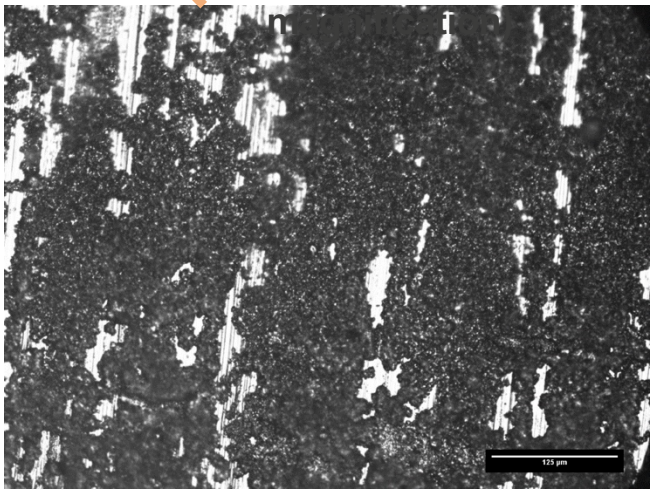
(20x)



(5x magnification)

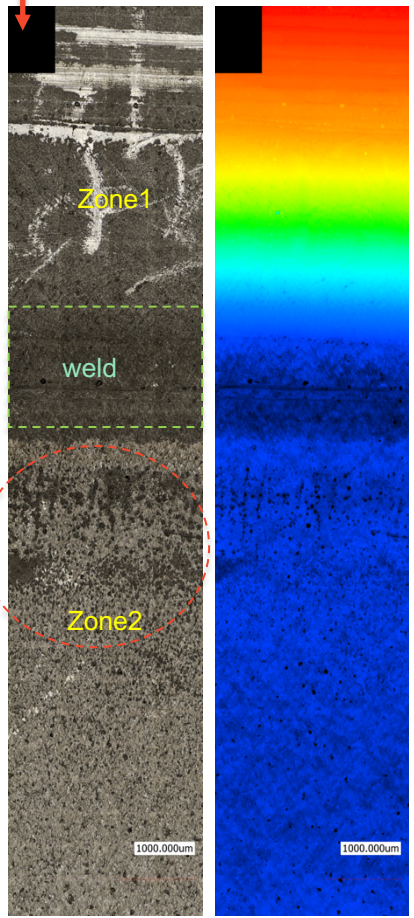


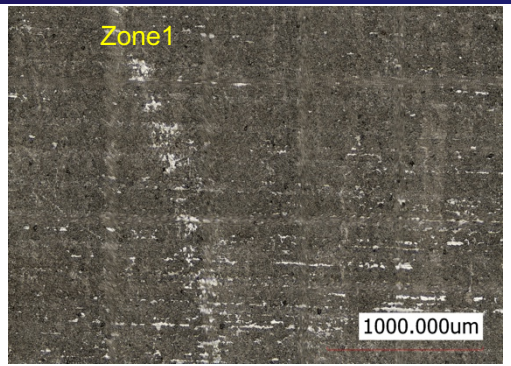
(20x)

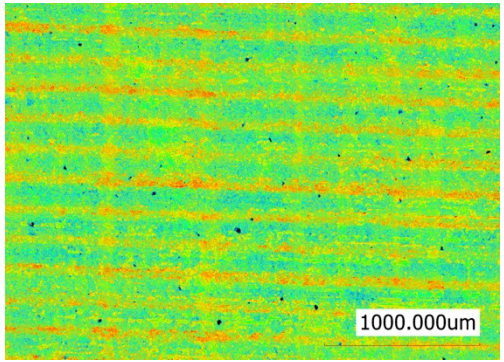


GRING18 LCM Images

Issues with imaging

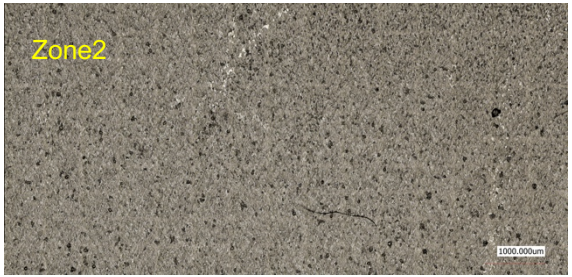


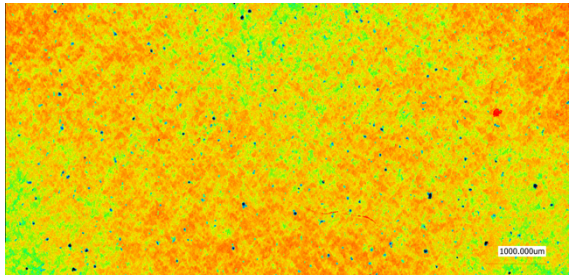




Small pits
Light surface corrosion

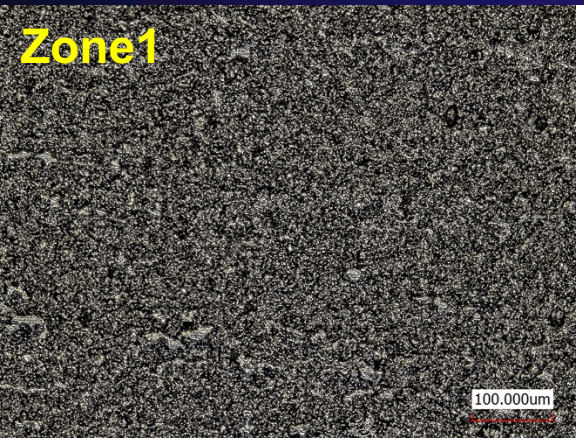
Corrosion appears to be different at both zones

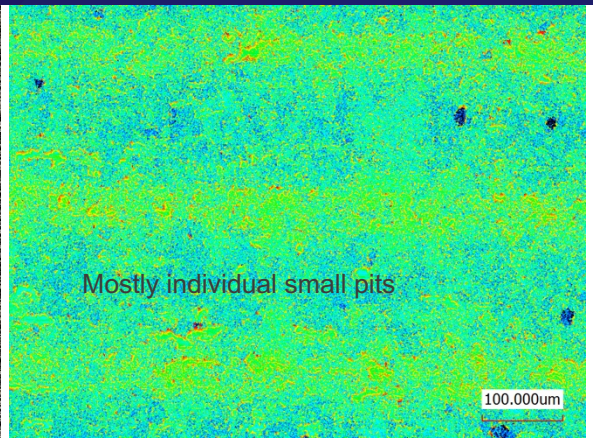


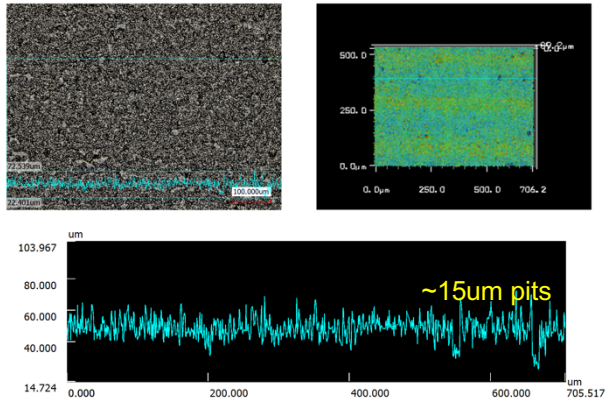


Larger pits
Lots of surface corrosion
Significant amount of pit agglomerate

Surface Damage

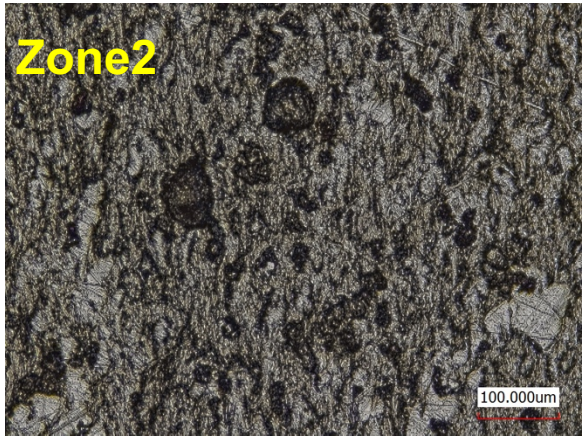


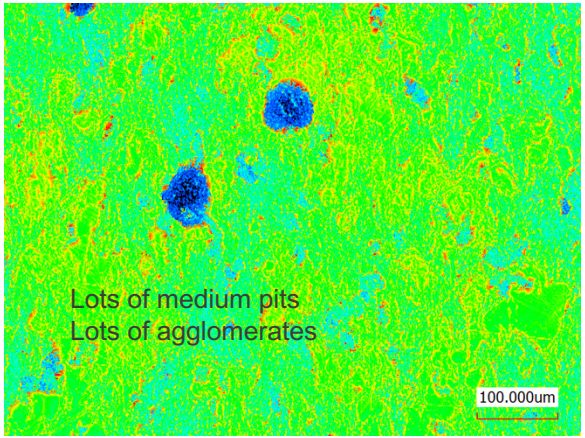


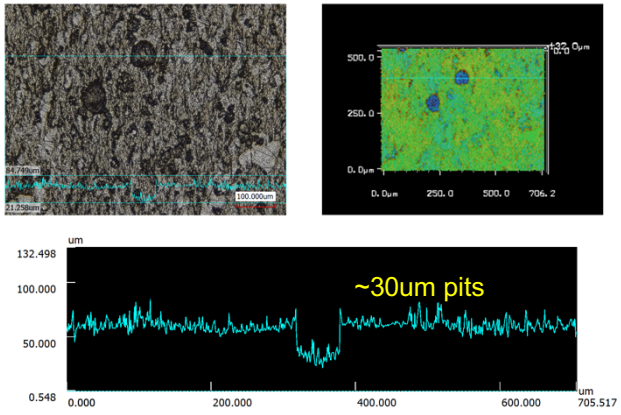


Different surface finish

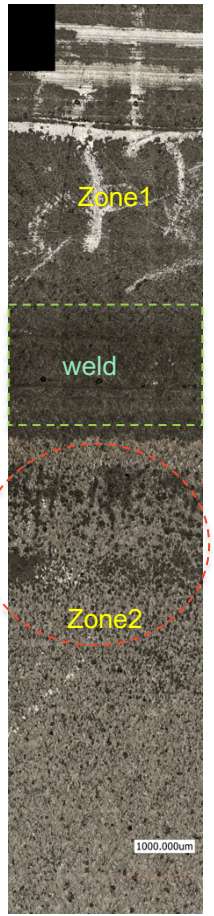
Appear to have different pit depths and diameters at different zones

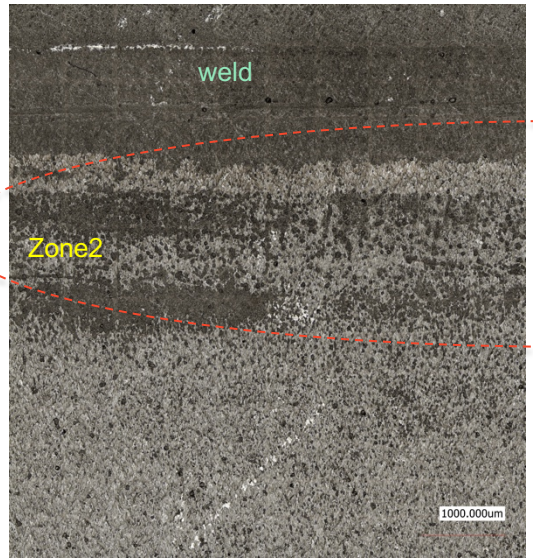


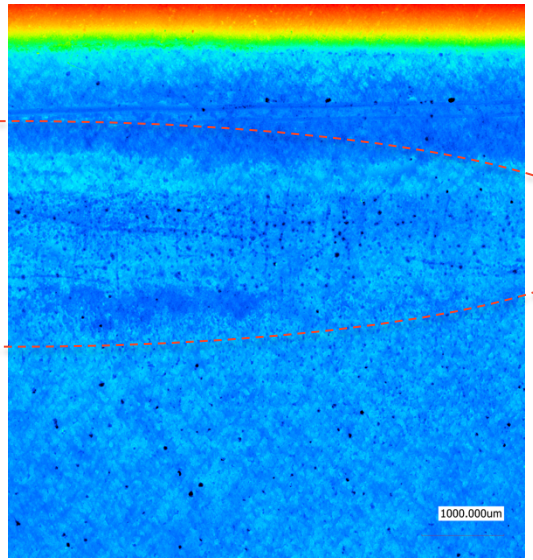




Corrosion Characteristics







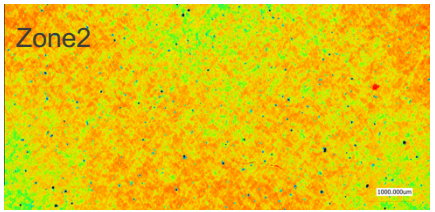
Area with significant surface damage, ~1600 um from weld, most likely due to heat affected zone, however pit depths are similar to those below that area

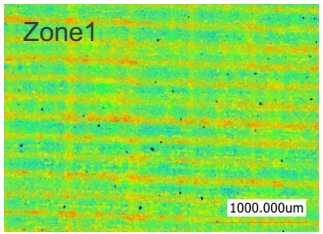
For single pits, pit diameters:

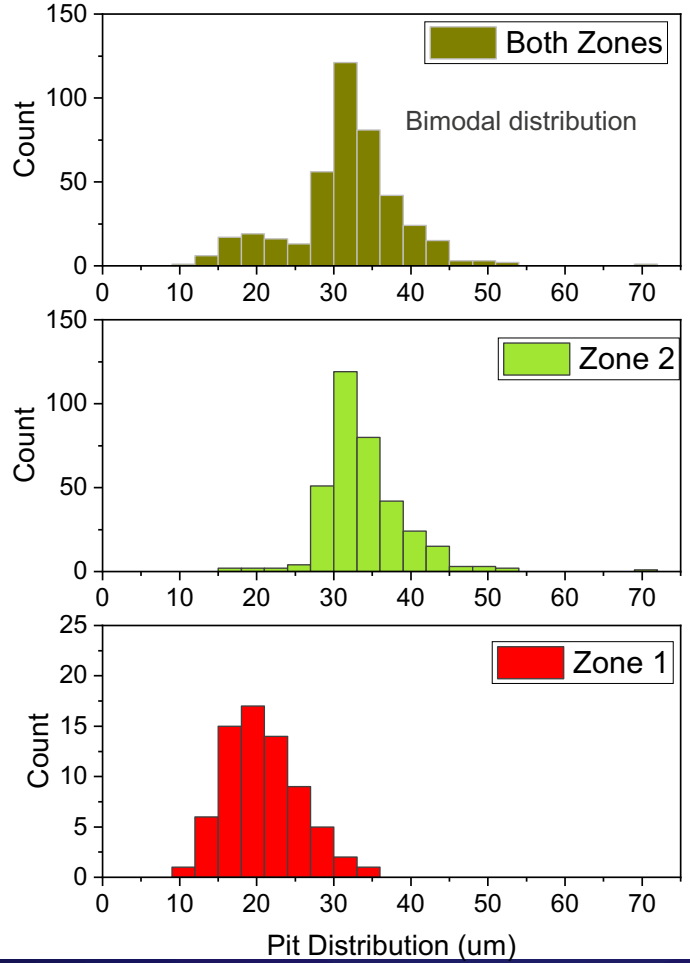
* Zone 1 are from few microns up to 30um
* Zone 2 are from few microns up to ~85um

Lots of pit agglomerates in zone-2

Pit Depth Statistics

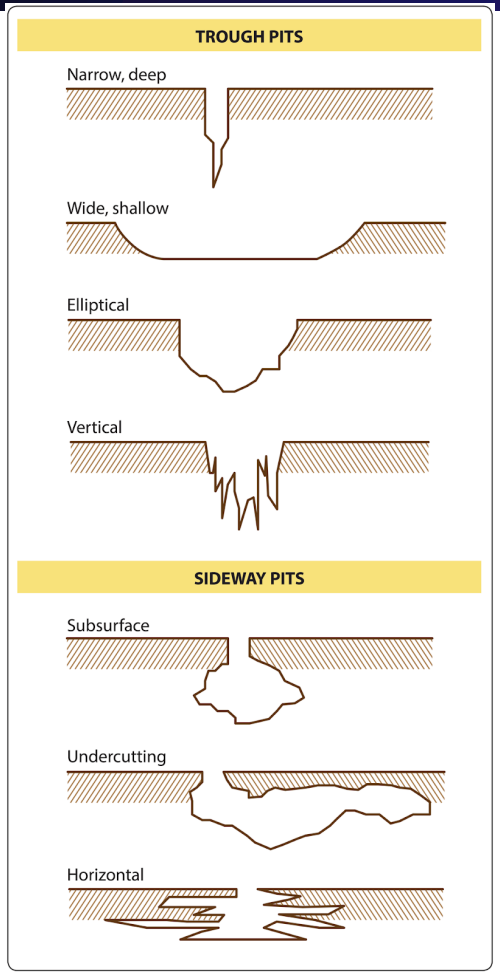


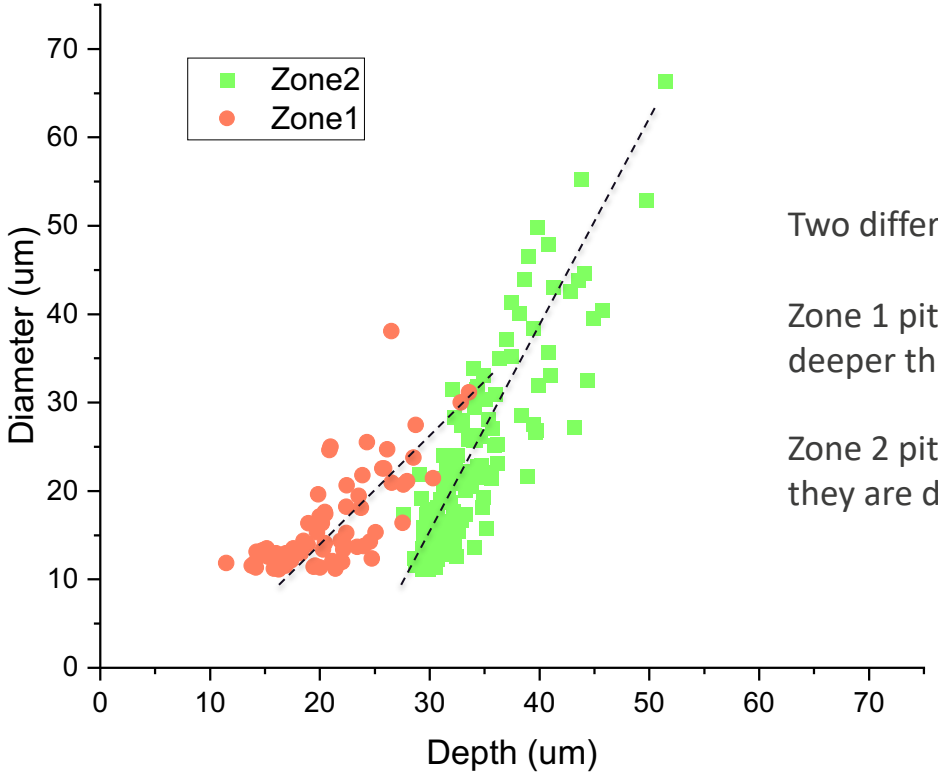




- Bimodal pit distribution
- Indication that surface has a significant effect on corrosion

Corrosion Pits Diameter Vs Depth





Two different slopes

Zone 1 pits tend to be deeper than they are wide.

Zone 2 pits are wider than they are deep.

Unable to determine with surface images

Observations

- No cracks observed
- Corrosion above/below weld is different. Likely due to differences in the steel.
  - GB microscope
    - Zone 2 pits ration were closer to 2.
  - LCM
    - Pits above weld are smaller in diameter and depth
    - Pits below weld are larger in diameter and depth
    - Diameter/depth ratio for pits below weld is >1.
    - This may be a good thing because in-GB screening measurements would be conservative if we assume 1.

The depths measured with GB-microscope aren't as close to LCM as hoped.

- Need to measure other cans to see if corrosion observations are consistent.
  - Therefore recommend cleaning and imaging 16H1, 18H7, and 19H5. We said we would do this last year. 18H7 and 19H5 show mostly surface erosion, but the LCM is so much better and you probably could get pit distributions. Because those are the worst 3 observed in surveillance, we definitely want to look for cracks.